

Testbed for Satellite and Terrestrial Interoperability (TSTI)  
A FY98 Program Product of 632-50-50 Communications - Terrestrial

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Testbed for Satellite and Terrestrial Interoperability  
(TSTI)

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**Objective**

Develop and demonstrate high degree of interoperability  
between satellite- and terrestrial-based networks

- Develop and evaluate enhancements to protocols such as ATM and TCP/IP
- Test and demonstrate new interface equipment hardware and software
- Utilize and showcase ACTS performance, especially its high data rate capabilities
- Extend HPCC network research program in Large Scale Networks
- Open to U.S. satellite and terrestrial communications carriers, equipment suppliers, and network providers

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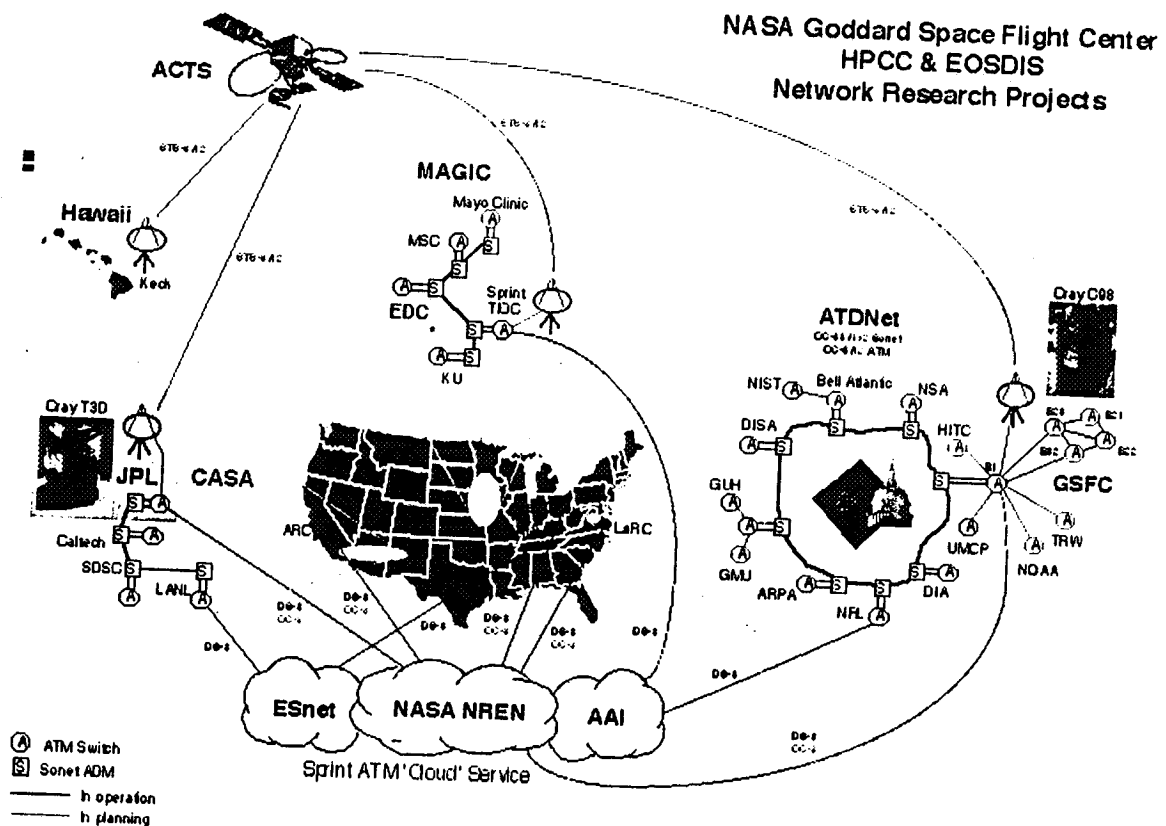
# Testbed for Satellite and Terrestrial Interoperability (TSTI)

## Specific Technical Objectives

Facilitate and conduct research and evaluations of new computer networking protocols and related technologies which improve the interoperability of satellite and terrestrial networks, e.g.,

- » TCP: large windows (RFC 1323), SACK (RFC 2018), XTP (RFC 1453)
- » IP: TAG (cisco), flow (Ipsilon), multi-protocol label switch (IETF), RSVP, multicasting, IPv6
- » ATM: MPOA, PNNI, available bit rate traffic management

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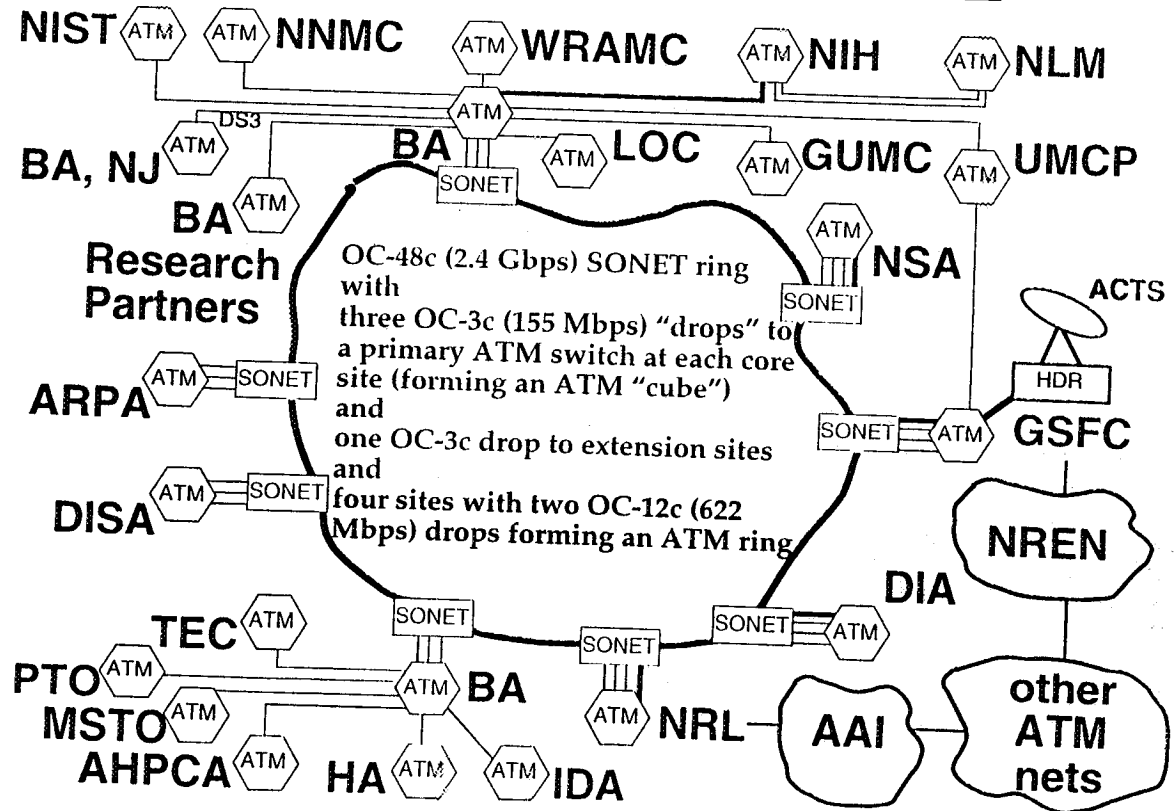
## 622 Mbps Network Tests Between ATDNet and MAGIC Via ACTS

## 2.0 Network Test Suites for the ATDNet-ACTS-MAGIC Network (AAMnet)

- ## ALIS-AIDnet-MAGIC Network (AAMNET) Topology Overview



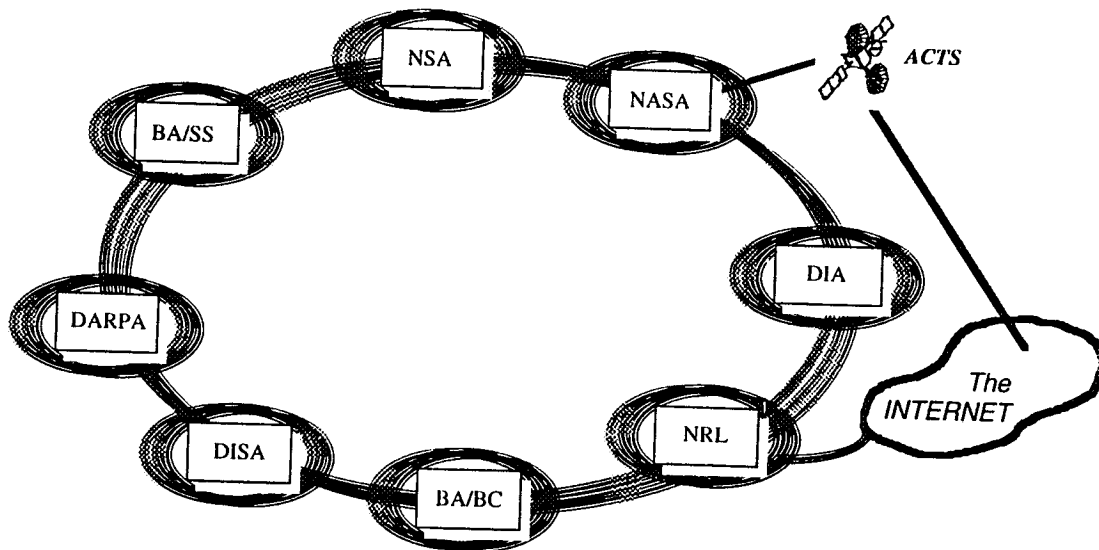
## ATDNet SONET/ATM Gigabit Network



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ATDNet with Multiwavelength Optical Network (MONET)- the system of the future  
 Department of Defense:

ATDnet++ ... A fully switched Wavelength Division Networking Testbed

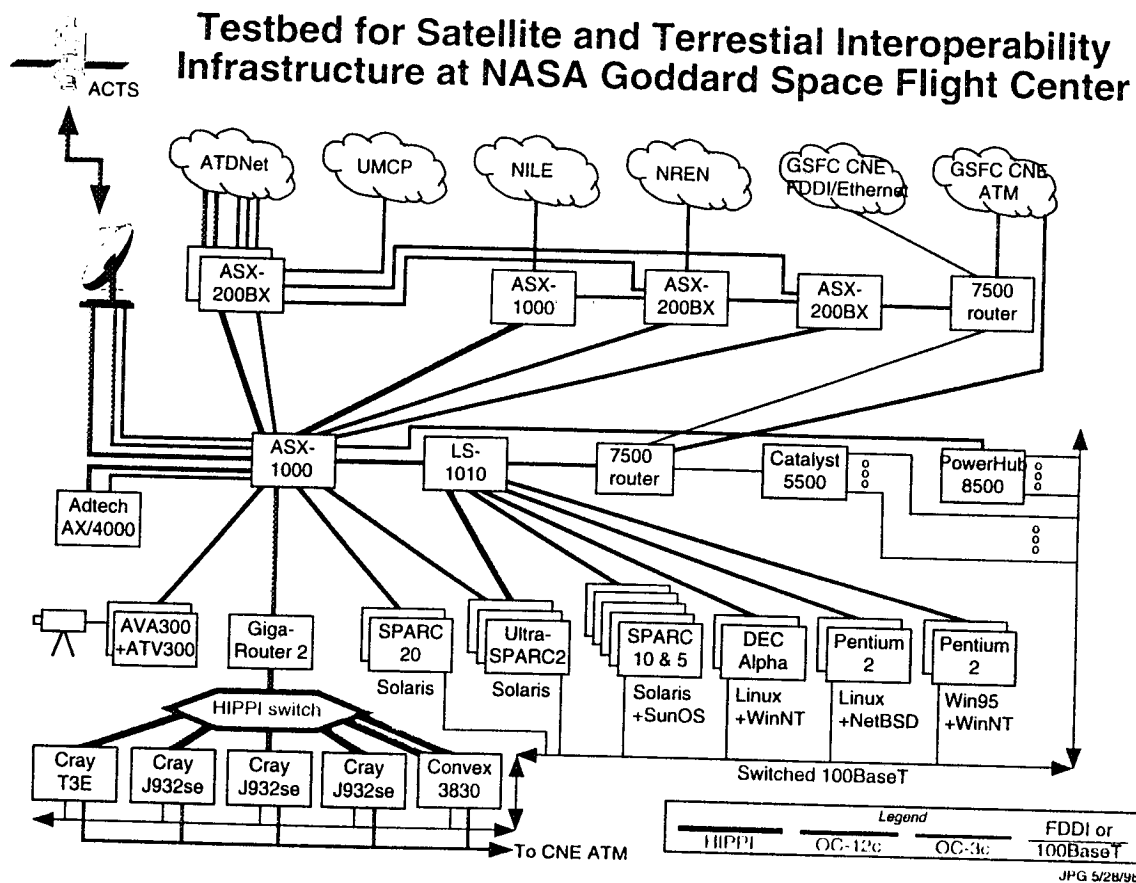


Proposed late 1999-2000 : Mixture of wavelength interchange & wavelength select devices

LEGEND:

WDN (n x 10.0 Gbps)  
 Autonomous Networks

BA- Bell Atlantic  
 SS - Silver Spring  
 BC - Bircroft



## Collaborations/End Sites with GSFC/930 In TSTI-based Evaluations - Present

<u>Applications</u>	<u>Sat./Terr. Carriers</u>	<u>Academia</u>	<u>Federal</u>
DGCM	ACTS Exp. #92	UCLA	GSFC/910, JPL
Telemedicine	AAMnet/#118g	[SFU]	NLM
Teleradiology	AAMnet/#118f	[WashU]	NIH
TerraVision	AAMnet/#118e		EDC, LeRC
Teleradiology	ATDNet-ACTS/#110	UHI, GUMC	[TAMC]
GLIN	ATDNet, Comsat/Intelsat	UMD(Balti.County)	LOC
Trans-Pacific DL	ATDNet, Comsat/Intelsat, ACTS/NREN, MPT/CRL		LOC, NLM, [Smithsonian,] National Library of Japan

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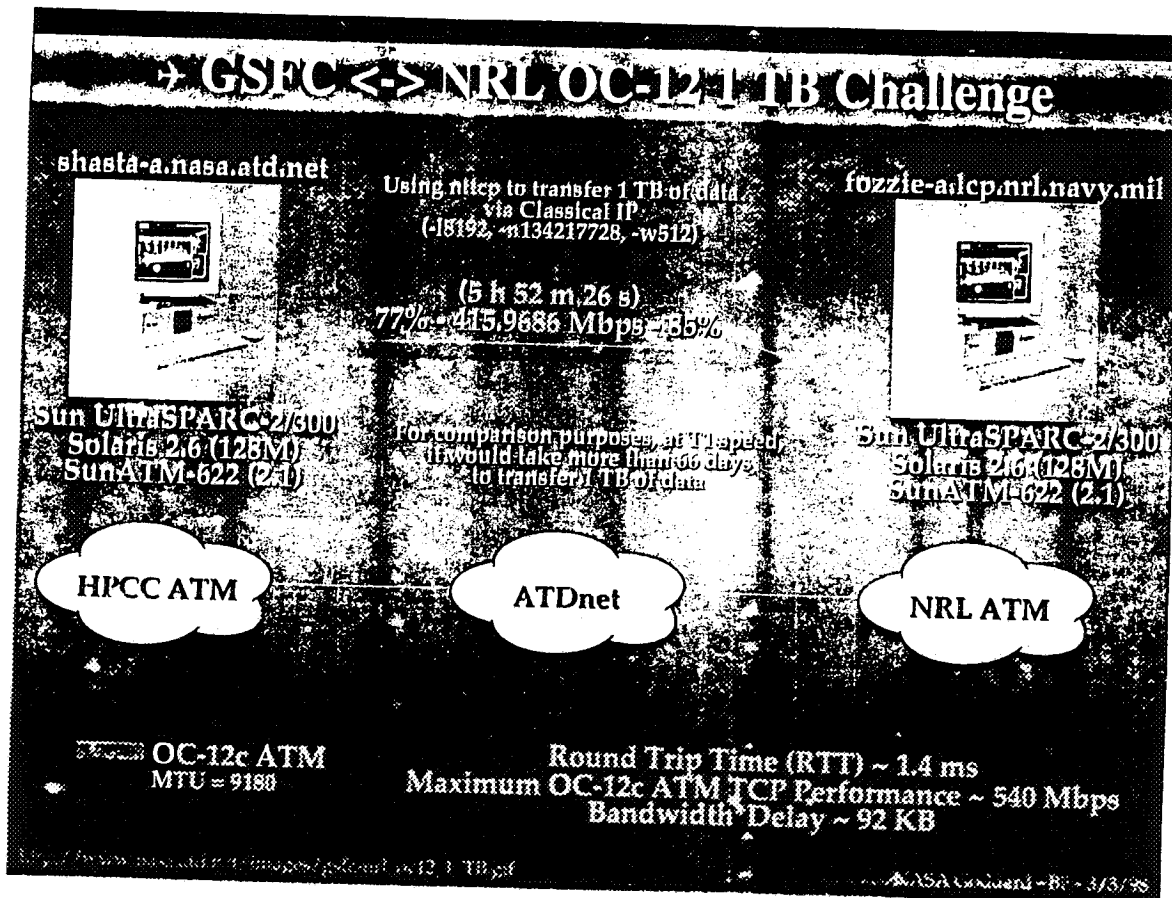
## Collaborations/End Sites with GSFC/930 In TSTI-based Evaluations - Present

<u>Technology</u>	<u>Industry</u>	<u>Academia</u>	<u>Federal</u>
TCP LFN (RFC 1323) TCP SACK (RFC 2018) XTP (RFC 1453)	PSC Mentat	KU UCLA Concordia U. (Quebec)	LeRC, JPL GSFC/505 & 540 Sandia N.L.
IP/TAG Switching (IETF MPLS WG) IPv6/RSVP	Ipsilon, Cisco		GSFC/505, ARC GSFC/505
ATM Transport Drivers ATM OC-3c Firewall ATM OC-12c Encryption	STK/NSC, SPOCK SECANT, SPOCK	UMD(College Park) NSA NSA NSA	

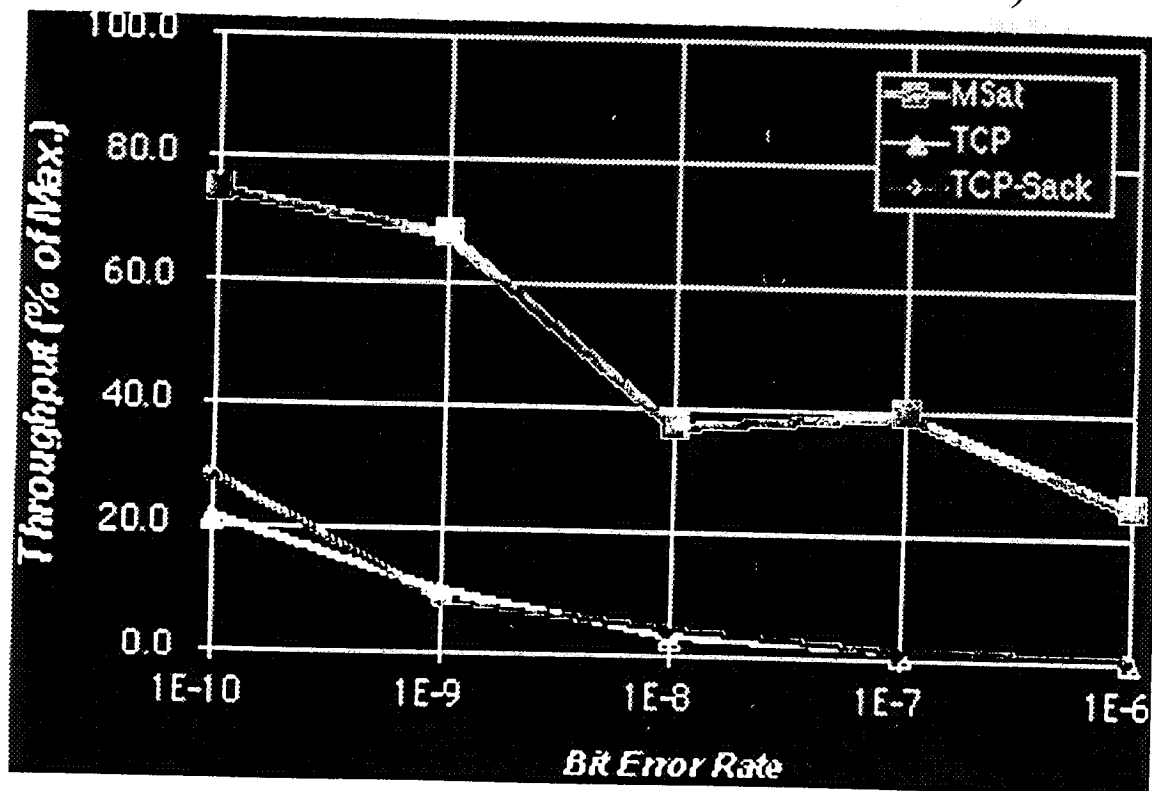
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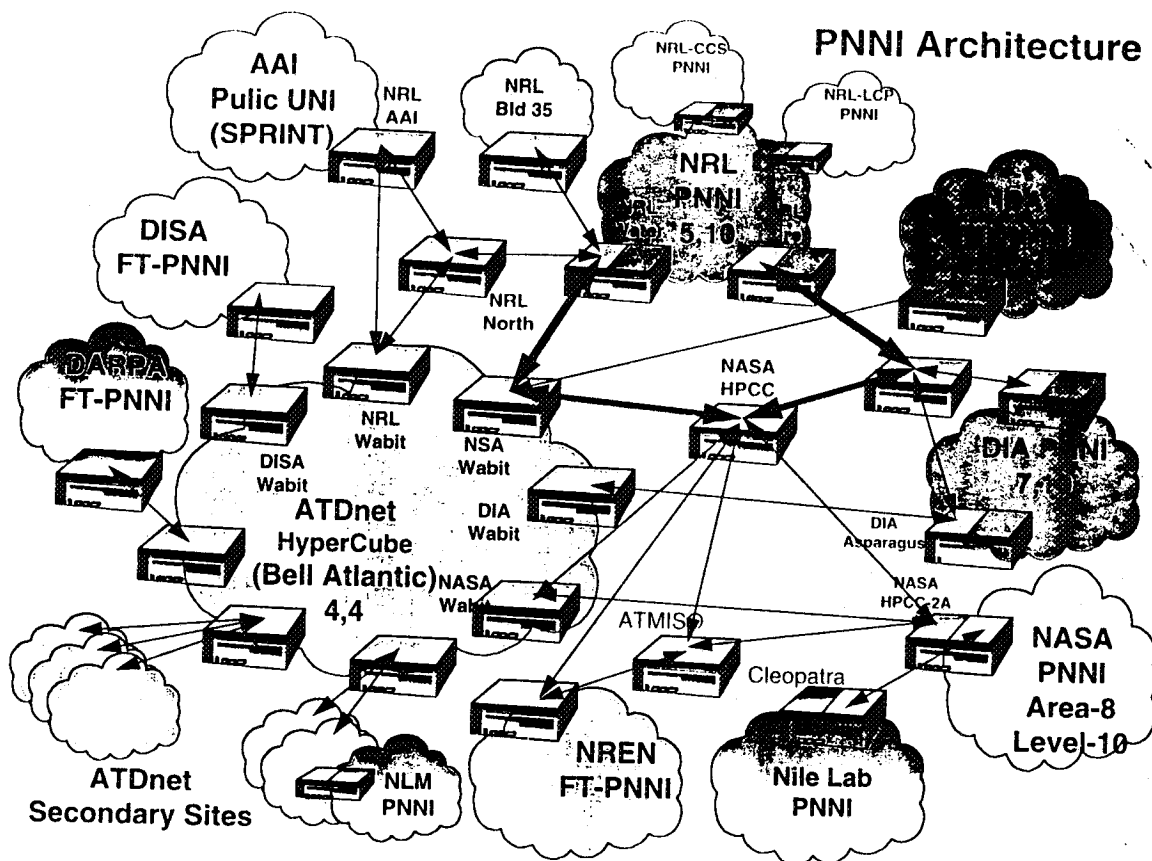
## Testbed for Satellite and Terrestrial Interoperability (TSTI) A FY98 Program Product of 632-50-50 Communications - Terrestrial

- Recent Major Accomplishments
  - » Enabled first use of ACTS high data rate capabilities by GUMC, KU, NIH, and NLM
  - » Monthly highlights online at <http://everest.gsfc.nasa.gov/month.html>
  - » Charalambos, C., et al., "Experimental and Simulation Performance Results of TCP/IP over High-Speed ATM over ACTS", <http://www.ittc.ukans.edu/~ccharala/research.html>
  - » LeRC set ACTS highwater throughput performance
    - 520 Mbps memory-to-memory
    - 320 Mbps aggregate (3 streams) tape-to-tape
  - » Protocol performance baselining by GSFC
    - TCP, TCP-SACK, XTP
    - BER: 0, 10E-11, 10E-10, 10E-9, 10E-8, 10E-7, 10E-6, 10E-5
    - Delay: 0, 5, 71, 540 ms



## Satellite Conditions (RTT = 540 ms)





## Trans-Pacific Digital Library Experiment

### Objectives

- Demonstrate and evaluate use of high performance satellite communications and advanced data communications protocols to enable interactive digital library data access between the U.S. Library of Congress, the National Library of Japan, and other digital library sites at 155 Mbps
  - » The satellite links demonstrate effective use of geostationary satellite-based communications in the Global Information Infrastructure
  - » The data communications protocols will include both standard protocols with recently specified options for performance enhancements and experimental protocols designed for improved performance
  - » Access will include interactive searches and retrievals of new on-line digital library data, and will promote an understanding of the need for ready access to these data

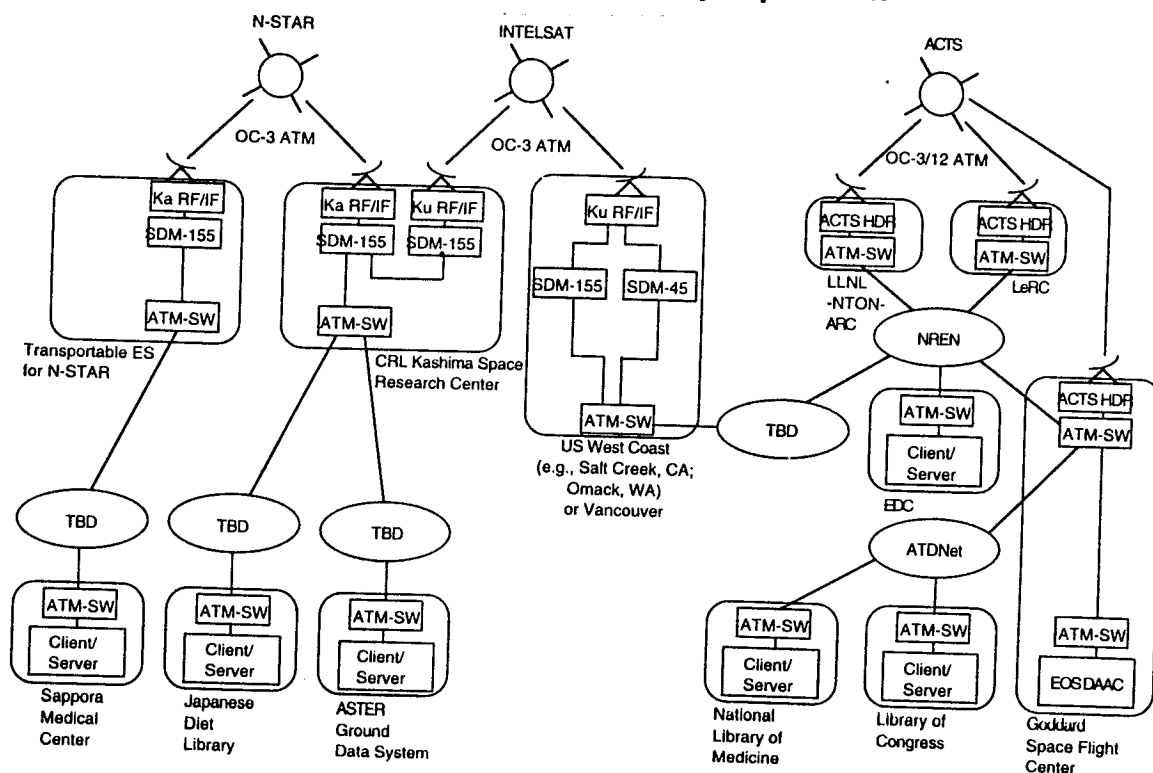


# Trans-Pacific Digital Library Experiment

## U.S.-led Applications

- Law Library of the Library of Congress
  - » Global Legal Information Network
- NASA Goddard Space Flight Center
  - » Trans-Pacific Access to GLOBE Visualizations in Real Time
- NIH National Library of Medicine
  - » Multi-Lingual Digital Anatomical Data Base
- USDA National Agricultural Laboratory
  - » Plant Genome Databases

**Configuration of Networks for Trans-Pacific Digital Library Experiment**



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## Testbed for Satellite and Terrestrial Interoperability (TSTI)

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- Major Milestones

- » FY98: TSTI development and instrumentation;  
Support for PI & Co-I's at GSFC, KU, LeRC, NIH, and NLM in 622 Mbps Network Tests between ATDNet and MAGIC via ACTS (Exp. #118) and for others (e.g., GUMC and GIBN Trans-Pacific Digital Library Experiment)
- » FY99: Complete evaluations of IP switching and ATM traffic management 4.0 explicit rate control in ABR;  
Enable/expand testbed for use by other GIBN projects and Satellite Alliance USA
- » FY00: Initiate evaluations of IP RSVP and ATM QoS parameters
- » FY01: Complete evaluations of IP RSVP and ATM QoS parameters

## ESDCD On-Going Network Projects

### More Info

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- AAMNet: ADTNet-ACTS-MAGIC Network (622 Mbps)
  - [http://everest.gsfc.nasa.gov/SCTB/AAMNET\\_plan.html](http://everest.gsfc.nasa.gov/SCTB/AAMNET_plan.html)
- ATDNet: Advanced Technology Demonstration Network
  - <http://www.atd.net/>
- GIBN DLE: Global Information Broadband Network Dig. Lib. Exp.
  - <http://dlt.gsfc.nasa.gov/gibn/>
- GLIN: Global Legal Information System
  - <http://lcweb2.loc.gov/law/GLINv1/GLIN.html>
- HECN: High End Computer Networking (for HPCC/ESS)
  - <http://everest.gsfc.nasa.gov/>
- TSTI: Testbed for Satellite and Terrestrial Interoperability
  - <http://everest.gsfc.nasa.gov/TSTI/TSTI.html>